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Two hypotheses were examined in this research project: (1) children with high level perceptual skills in the initial assessment will retain their advantage but will grow less in skills than children with low level skills development at the outset; and (2) after a period of skills development, children with high level skills development will show greater readiness for the first grade than children with lower levels of skills development. Subjects were 132 kindergarten children, divided into six classes by ability, who were assessed individually prior to and after 6 months of the program. To measure growth, the Illinois Test of Psycholinguistic Abilities and the Metropolitan Readiness Tests were employed. The first part of the first hypothesis was supported, but the second part was not. The second hypothesis was supported. In general, the skills development program markedly contributed both to higher scores in skills development after 6 or 8 months and to greater than normal growth of the children. (DO)

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KINDERGARTEN RESEARCH STUDY:

LEVEL OF SKILLS DEVELOPMENT RELATED TO GROWTH IN SKILLS AND TO READINESS FOR THE FIRST PRIMARY YEAR

PS001041

Office of
Research and Testing

SCHOOL DISTRICT OF UNIVERSITY CITY
University City, Missouri

December 1967

KINDERGARTEN RESEARCH STUDY
LEVEL OF SKILLS DEVELOPMENT RELATED TO GROWTH IN SKILLS AND TO READINESS FOR THE FIRST PRIMARY YEAR

Originally the study of the readiness for the first primary year of kindergarten children in a skills development program contemplated the use of control groups from typical kindergarten programs for comparison. This approach was not feasible as adequate control data could not be obtained. As an alternative, data on 135 children in six developmental skills kindergarten classes, representing high, average, and low ability were studied. Ability was estimated by the language quotient (L.Q.) derived from the Illinois Test of Psycholinguistic Abilities (ITPA) (1) administered as a pretest. A skills development program (motor, auditory, visual, language, cognitive) was provided to each child based on his identifiable strengths and weaknesses. A modification of Osgood's model (2,3) upon which the skills development assessments and programs were based is described briefly in Appendix A. The programs themselves were similar to those for prekindergarten children which were described in two Interim Reports to the United States Office of Education (4, 5).

HYPOTHESES

Two hypotheses were examined:

1. In a perceptual skills development program, children having high level developmental skills in the initial assessment will retain their advantage but will show less growth in skills than children with low level skills development at the outset.

2. After a period of skills development activities, children having high level skills development will show greater readiness for the first primary year than children with lower levels of skills development.

RESEARCH DESIGN

Six kindergarten classes (A through F) of 22 or 23 children each were selected to represent high, average, and low ability groups. Developmental skills were assessed individually prior to and after approximately six months (eight months for class E) of the program together with end of year readiness testing.

Variables.

The skills development program constituted the independent variable; age, sex, and the Illinois Test of Psycholinguistic Abilities (ITPA) pretest were used as control variables.

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The dependent variables to measure outcomes included ITPA total raw score and Metropolitan Readiness Tests (reading, number, and total readiness raw scores) (6).

Analysis of Data.

Data pertaining to the control and dependent variables were treated statistically to determine the significance of mean differences, if any, among the six classes for boys and girls separately by multivariate analysis of variance (MANOVA) (7) using a Fortran computer program. (See Appendix B.) This analysis provides two tests of significance:

1. The Wilk's lambda test to determine the overall significance of correlated variables.

2. A set of univariate F tests to determine the significance of each variable among the groups, assuming independence.

These tests are expressed in terms of p (percentage) values. In both tests, for example, p less than .001 indicates less than one tenth of one percent possibility the findings resulted by chance. In this study, p greater than .05 is considered not significant (ns). Following these analyses, the usual t-test procedures, reported later, can be applied with considerable confidence.

RESULTS

ITPA Pretest and Control Data.

ITPA pretest results providing mean raw scores, separately for boys and girls, were used to identify high, average, and low ability classes. That some of these classes differed statistically from others is indicated by the Wilk's lambda test of p less than .001 and the univariate F test of p less than .001. The results are given in Table 1.

Table 1 is read: On the pretest prior to beginning the skills development program, boys in class E were 5 years, 4 months old on the average and obtained a mean test score of 6 years, 10 months derived from a mean raw score of 164 with a resulting 125 L.Q. for the total test. The raw score was significantly higher statistically than raw scores of boys in classes A, B, and C and higher than the average of the six classes. Calculations for boys identified classes E and F as high, classes D and A as average, and classes B and C as low. They identified for girls, class E as high, classes F, D, and A as average, and classes B and C as low. The classifications for both boys and girls were the same except for class F in which boys were high and girls were average when compared to the other classes. Although these analyses were based on raw score data, the mean L.Q.'s of each class assumed the same relative positions. Tables C-1 and C-2 in Appendix C provide the t-test analyses separately for boys and girls.

Table 1. ITPA Pretest Total Raw Score Differences Separately for Boys and Girls in the Six Classes

Class/ Sex	Pupils Mean Age	ITPA Total Mean			Scores Significantly Higher than	Classification of Group
		Test Age	Raw Score	L.Q.		
BOYS						
E	5-4	6-10	164	125	A,B,C,Ave.	High
F	5-9	6-9	161	118	A,B,C,Ave.	High
D	5-9	6-7	159	116	B,C	Ave.
A	5-6	6-2	148	113	B,C	Ave.
Ave.	5-7	5-11	141	108	B,C	--
B	5-5	5-3	121	92	--	Low
C	5-6	4-7	100	76	--	Low
GIRLS						
E	5-5	6-9	161	123	A,B,C,Ave.	High
F	5-5	6-5	154	118	B,C	Ave.
D	5-7	6-3	150	115	B,C	Ave.
A	5-8	6-2	148	113	B,C	Ave.
Ave.	5-7	6-0	143	109	C	--
B	5-5	5-6	127	97	--	Low
C	5-6	4-10	107	81	--	Low

Wilk's lambda test: p less than .001
Univariate F test: p less than .001

Age of the children was similar in the six classes as shown in Table 2 except that the mean ages of boys in classes D and F were significantly greater statistically than of boys in class B. This fact gave a slight advantage to D and F boys and a disadvantage to B boys which apparently did not affect the posttest outcome appreciably as none of these classes placed at either the high or low extremes. The mean age of girls in class A was significantly greater statistically than of girls in class B, again of little apparent consequence with respect to posttest results.

Table 2. Age Differences among the Six Classes Separately for Boys and Girls

School/ Sex	Age in Months 4-30-67	Significantly Higher than	Rank
BOYS			
D	75.2	B[a]	1½
F	75.2	B[b]	1½
Ave.	72.8		Ave.
E	72.6		3
A	72.5		4
C	72.4		5
B	71.0		6
GIRLS			
A	74.6	B[c]	1
E	73.7		2
D	73.4		3
Ave.	73.0		Ave.
C	71.9		4
F	71.7		5
B	71.6		6

The sexes were distributed about equally in the six classes except class D had considerably more girls than boys (a possible advantage in skill development and readiness) and class B had considerably more boys than girls (a possible disadvantage). This fact may have been somewhat reflected in, but apparently did not appreciably influence, the posttest results. Two-tailed t-tests were not computed.

ITPA Posttest Results.

Similar calculations for the ITPA posttest raw scores indicated the Wilk's lambda test as p less than .001 and the univariate F test as p less than .001. Data for boys showed class E remained high, class F joined class D as high average, class A continued as average, and classes B and C remained low. Girls' classes retained the same classifications as on the pretest. These data are provided in Table 3. The t-test analyses are given in Tables C-1 and C-2 of Appendix C.

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[a] $t = 2.65 > .02$

[b] $t = 3.27 > .01$

[c] $t = 2.23 > .05$

It should be emphasized that although the classification of high, average, and low maintained substantially the same relative positions on both pretest and posttest, this fact does not imply lack of, but rather relatively comparable development of the children in the six classes. However, one exception was identified. The incident in which class F moved from the high to high average classification may be explained in part by the teacher's emphasis on the initial teaching alphabet (i.t.a.) which was not measured, rather than on perceptual skills development which was the focus of this study.

Table 3. ITPA Posttest Total Raw Score Differences Separately for Boys and Girls in the Six Classes

Class/ Sex	Pupils Mean Age	ITPA Total Mean			Scores Significantly Higher than	Classification of Group
		Test Age	Raw Score	L.Q.		
BOYS						
E	6-0	9-4+	204	148+	A, B, C, D, F, Ave.	High
D	6-3	7-11	184	128*	A, B, C	High Ave.
F	6-3	7-7	179	123*	A, B, C	High Ave.
Ave.	6-1	6-10	164	121	C	--
A	6-1	6-7	157	114	C	Ave.
B	5-11	6-2	148	106	--	Low
C	6-1	5-5	126	86	--	Low
GIRLS						
E	6-1	9-4+	207	148+	A, B, C, D, F, Ave.	High
D	6-1	7-7	178	133	A, B, C	Ave.
F	6-0	7-7	178	133	A, B, C	Ave.
Ave.	6-1	7-1	168	124	B, C	--
A	6-3	6-8	160	104*	C	Ave.
B	6-0	6-2	147	105	--	Low
C	6-0	5-6	129	89	--	Low

Wilk's lambda test: p less than .001
Univariate F test: p less than .001

*Note - Had the children been one month younger, the norms, provided only in six months intervals, would have shown considerably higher L.Q.'s as follows:
D boys - 139 L.Q. rather than 128 L.Q.
F boys - 134 L.Q. rather than 123 L.Q.
A girls - 117 L.Q. rather than 104 L.Q.

Posttest-Pretest Growth.

During the six months' period, the growth of boys in total ITPA raw score in the six classes ranged from 9 to 40 points (5 to 30 months); for girls the range was 12 to 46 points (8 to 31 months). Statistical analysis of data for boys showed the Wilk's lambda test as p less than .028 and the univariate F test as p less than .002. For girls the Wilk's lambda test was p less than .008, the univariate F test was p less than .001. In each instance confidence in the results was warranted. Figures 1 and 2 show this growth graphically for boys and girls respectively. The t-test data are given in Tables C-1 and C-2, Appendix C.

Figure 1 is read: In class E, the growth score of boys was 40 points (30 months) which was significantly higher than of boys in classes (A, B, D, F) and of the average for the six classes. Subtracting the gain from the length of instruction gave a gain of 22 months above expectation. Boys in classes D and B, and the average scored significantly higher than boys in class A. Other growth score differences were not statistically significant.

The figure indicates that boys in the full-day class E who were also the highest group on both the ITPA pretest and posttest measures surpassed boys in all other classes. This growth may have resulted from either the longer period of instruction or from higher ability, or both. The present data cannot provide an explanation.

D boys made the second largest gain, 10 months above expectation, although they were only average on the pretest.

F boys (second highest on the pretest), and B and C boys (both low on the pretest) made gains of four or five months above expectation. The F boys had i.t.a. instruction rather than developmental skills activities which may account for the second highest group making only four months gain above expectation. The impact of i.t.a. on boys in class F can be judged more realistically after a follow-up study at the end of the first primary year.

Boys in class A, although average on the pretest, grew least of those in any of the six classes. This slower growth may have resulted from the teacher's giving less emphasis to developmental skills programs than to other activities during most of the school year.

With the exception of A boys, boys in all skills developmental classes gained well beyond expectation.

SCALE	PRETEST Raw Score	PRETEST Age Score	CLASS	GROWTH CHART	CLASS	POSTTEST Raw Score	POSTTEST Age Score	GROWTH SIGNIFICANTLY Greater than Class	RAW SCORE GAIN	GAIN IN MONTHS ABOVE EXPECTATION
200					E	204	9-4+	A, B, D, F, Ave.	40	22
180					D	184	7-11	A	25	10
					F	179	7-7	-	18	4
	164	6-10	E		Ave	164	6-10	A	23	5
160	161	6-9	F							
	159	6-7	D		A	157	6-7	-	9	-1
	148	6-2	A		B	148	6-2	A	27	5
140	141	5-11	Ave							
					C	126	5-5	-	26	4
120	121	5-3	B							
100	100	4-7	C							

Figure 1. Significance of Posttest-Pretest Growth of Boys in the Six Classes

Figure 2 is read: Girls in the full-day class E, whose scores were highest on both the ITPA pretest and the posttest, surpassed girls in all other classes with a gain beyond expectation of 24 months. Whether high ability or the longer school day is responsible cannot be determined from the present data.

D girls who ranked third on the pretest and second on the posttest made the second largest gain beyond expectation, 11 months.

F girls who ranked second on both the pretest and the posttest, gained 8 months beyond expectation. Again, the influence of i.t.a. is not presently known.

A girls who were average on the pretest and the posttest, and B and C girls who were low on both tests made gains of 0, 2 months, and 2 months respectively beyond expectation.

In general, ability considered, all classes except A girls made good gains beyond expectation.

SCALE	PRETEST Raw Score	PRETEST Age Score	CLASS	GROWTH CHART	CLASS	POSTTEST Raw Score	POSTTEST Age Score	GROWTH SIGNIFICANTLY Greater than Class	RAW SCORE GAIN	GAIN IN MONTHS ABOVE EXPECTATION
200					E	207	9-4+	A, B, C, D, F, Ave.	46	24
180					D	178	7-7	-	28	11
					F	178	7-7	A	24	8
					Ave	168	7-1	A	25	7
160	161	6-9	E		A	160	6-8	-	12	0
	154	6-5	F							
	150	6-3	D							
	148	6-2	A		B	147	6-2	-	20	2
140	143	6-0	Ave							
	127	5-6	B		C	129	5-6	A	22	2
120										
	107	4-10	C							
100										

Figure 2. Significance of Posttest-Pretest Growth of Girls in the Six Classes

Readiness for the First Primary Year.

The Metropolitan Readiness Tests (6) data were treated statistically in the same manner as those on the ITPA pretest and posttest. For boys, the Wilk's lambda test was p less than .003 and for girls p was less than .011, indicating the presence of significant mean raw score differences in some dependent variables (test results) among the six classes. The univariate F tests, identifying which of the dependent variables showed significant differences, are given in Table 4.

Table 4. Univariate F Tests of Raw Scores on the Metropolitan Readiness Tests, Separately for Boys and Girls

Subtest	Univariate F Test of p Less than	
	Boys	Girls
Reading Readiness	.076*	.292*
Number Readiness	.001	.013
Total Readiness	.004	.124*

*Univariate F test greater than p less than .05 level are not considered significant.

Table 4 is read: In reading readiness, the univariate F test of p less than .076 for boys indicates the possibility that, of 100 dependent variables, 7.6 percent of those shown by t-tests to be significantly different may be significant only by chance. Likewise, in reading readiness for girls, 29.2 percent of the t-tests could be significant by chance, and, in total readiness, 12.4 percent of the t-tests could be significant by chance. The data should be interpreted with these limitations in mind. The t-test analyses are given in Tables C-3 for boys and C-4 for girls, in Appendix C.

Tables 5 and 6 provide data on readiness for boys and for girls in the six classes.

Table 5 is read: in reading readiness, boys in class D scored significantly higher than boys in classes A, B, C, F, and the group average. E boys significantly surpassed boys in classes A, B, and C. Data on the remaining schools is interpreted in the same manner. Remember, the data on reading readiness scores should be interpreted with caution because some of the variables can be significant only by chance. Data for boys on number and total readiness, however, can be interpreted with confidence.

Table 5. Metropolitan Readiness Tests Raw Score Differences of Boys among the Six Classes

Subtest/ Class	Metropolitan Readiness Test Mean		Scores Significantly Higher Than	Classification of Groups
	Letter Rating-Percentile	Raw Score		
READING				
D	A	63.7	A,B,C,F,Ave.	High
E	A	61.7	A,B,C	High Ave.
F*	B	60.5	B,C	Ave.
A*	B	58.3	B,C	Ave.
Ave.	B	56.7	C	--
B	C	52.8	--	Low
C	C	44.7	--	Low
NUMBER				
E	A	22.0	A,B,C,Ave.	High
D	A	20.5	B,C	Ave.
F*	B	20.1	B,C	Ave.
A*	B	19.7	B,C	Ave.
Ave.	B	18.1	C	--
B	B	15.9	C	Ave.
C	C	10.0	--	Low
TOTAL				
E	A-98	93.4	A,B,C,Ave.	High
D	A-98	93.2	A,B,C	High
F*	A-95	90.1	B,C	Ave.
A*	B-88	86.3	B,C	Ave.
Ave.	B-79	82.4	C	--
B	C-61	74.9	C	Ave.
C	D-23	57.9	--	Low

*Note: Classes F and A emphasized activities other than prenumerical skills development.

Table 6 is read in the same manner as Table 5. Again, data on reading and total readiness for girls should be interpreted with caution while data on number readiness can be interpreted with confidence.

Table 6. Metropolitan Readiness Tests Raw Score Differences of Girls among the Six Classes

Subtest/ Class	Metropolitan Readiness Test Mean		Scores Significantly Higher than	Classification of Groups
	Letter Rating-Percentile	Raw Score		
READING				
D	A	63.1	A,B,C,E,Ave.	High
F*	A	62.8	A,B,C	High Ave.
E	A	61.3	A,B,C	High Ave.
Ave.	B	58.1	C	--
A*	B	57.6	C	Ave.
B	C	54.8	C	Ave.
C	D	45.8	--	Low
NUMBER				
D	A	22.4	B,C,F,Ave.	High
E	A	21.7	B,C	Ave.
A*	A	21.2	B,C	Ave.
F*	A	20.8	B,C	Ave.
Ave.	B	20.0	C	--
B	B	18.0	C	Ave.
C	C	13.3	--	Low
TOTAL				
D	A-99	94.4	A,B,C,Ave.	High
F*	A-98	92.8	B,C	Ave.
E	A-97	92.3	B,C	Ave.
A*	B-92	87.5	B,C	Ave.
Ave.	B-88	86.3	C	--
B	B-73	79.8	C	Ave.
C	D-35	64.0	--	Low

*Note: Classes F and A emphasized activities other than perceptual skills development.

DISCUSSION AND CONCLUSIONS

Each of six classes of kindergarten children was ranked by ability as determined by the ITPA total raw score, boys and girls being classified separately. Each class was compared with the five other classes and with the group average on pretest and control data, posttest results, posttest-pretest growth, and readiness for the first primary year. The rank order of the six classes from high to low on the pretest, posttest, and readiness for reading, number, and total score is diagrammed in Figure 3. The shaded boxes indicate tests for which the score differences may have been significant only by chance. In reading Figure 3 it should be remembered that class F gave more emphasis to i.t.a. than to skills development while class A pursued the usual kindergarten activities rather than those prescribed for the experimental classes. In general, the classes, while showing considerable growth in skills and substantial readiness for the first primary year, retained their same relative positions, with few exceptions, in all five measures.

The data suggest that the skills development programs in all classes except class A contributed to the increased skills of children beyond normal expectation. In a negative way, the fact that class A which followed the usual kindergarten curriculum and showed no unusual growth in skills, also tends to emphasize the value of experimental programs in developing children's motor, auditory, visual, language, and cognitive abilities.

Reading and total readiness, although strong, were less affected by the program than were children's basic perceptual skills. It may be that six (or eight) months of instruction is too short a period for markedly significant results in reading readiness. However, number readiness definitely responded to the special program. The real significance of the skills development programs will be tested by measures of achievement at the end of the first primary year.

Figure 3 is read: Boys in class E ranked highest on ITPA raw score and L.Q. on both the pretest and the posttest. In reading readiness E boys fell to rank 2 but they regained the highest rank in number and total readiness.

Boys in class F ranked second on the ITPA pretest, and third on the posttest, which position they maintained on the three Metropolitan tests. The exchange of places of F boys with D boys on the ITPA posttest, (not statistically significant) probably reflects the teacher's emphasis on i.t.a. rather than on skills development which characterized four of the six classes.

Boys in class A which pursued the usual kindergarten program dropped in the ITPA posttest but retained their relative position on the three readiness tests. B and C boys retained the lowest positions on all five measures.

Data for girls were similar and is interpreted in the same manner.

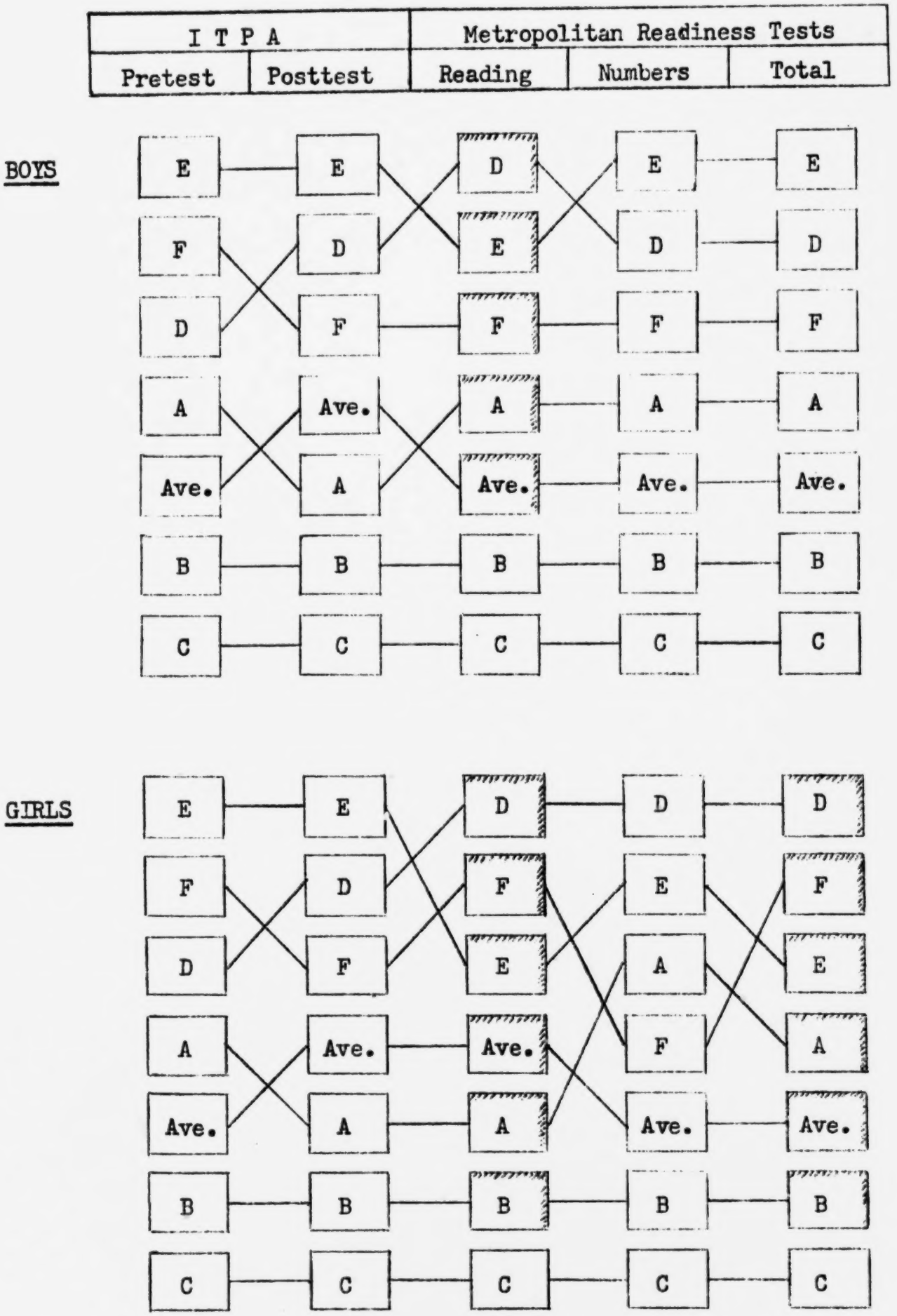

Figure 3. Rank Order of Raw Scores on the ITPA Pretest and Posttest, and Metropolitan Reading, Number, and Total Readiness by Class and by Sex

NOTE: Shaded boxes indicate the need for cautious interpretation.

The first hypothesis--in a perceptual skills development program, children having high developmental skills in the initial assessment will retain their advantage--was generally supported by the findings with few changes in rank order of classes on the ITPA pretests and posttests. Not only did the full-day class with eight months' instruction retain first rank but also the next two highest ability classes, although reversing positions, retained second and third ranks. Likewise, the remaining classes retained their lower positions. The pattern of both boys and girls was substantially the same.

The second part of the first hypothesis--that children having high level development on the initial test will show less growth in skills than children with low level skills development at the outset--was not substantiated. Growth was greatest for the full-day class and next greatest for the class which ranked third on the ITPA pretest. The fact that the second ranking class did not show as much growth may have resulted from the emphasis given to i.t.a. rather than to skills development. The remaining classes each grew approximately the same number of months except class A which received the usual kindergarten program and did not exceed expectation. These trends also were similar both for boys and for girls.

The second hypothesis--after a period of skills development activities, children having high level skills development will show greater readiness for the first primary year than children with lower levels of skill development--was supported. With the exception of slight individual class variations, children scoring higher on the ITPA posttest also scored higher on readiness tests than children who scored lower on the ITPA posttest.

In general, the skills development programs markedly contributed both to higher scores in skills development after six (or eight) months and to greater than normal growth of the participating children. The programs had a measurable impact on readiness for the first primary year in number readiness of both boys and girls and in total readiness of boys. However, findings on reading readiness were less conclusive and must await the results of achievement testing at the end of the first primary year.

JMD:es

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APPENDIX A

A MODEL FOR DEVELOPING INTELLECTUAL ABILITIES AND A DESCRIPTION OF THE TESTS USED

The experimental kindergarten design was based on a modification of Osgood's model (2, 3) for developing intellectual abilities, Figure A-1. The model identifies three operations (reception, cognition, expression) necessary in intellectual growth. Operations are approached through the acquisition of five major developmental skills (motor, auditory, visual, cognition, and verbal), each interrelated and ranging from low to high meaning level. In the model, the arrows indicate that growth in developmental skills varies with individual children and does not necessarily follow a continuum.

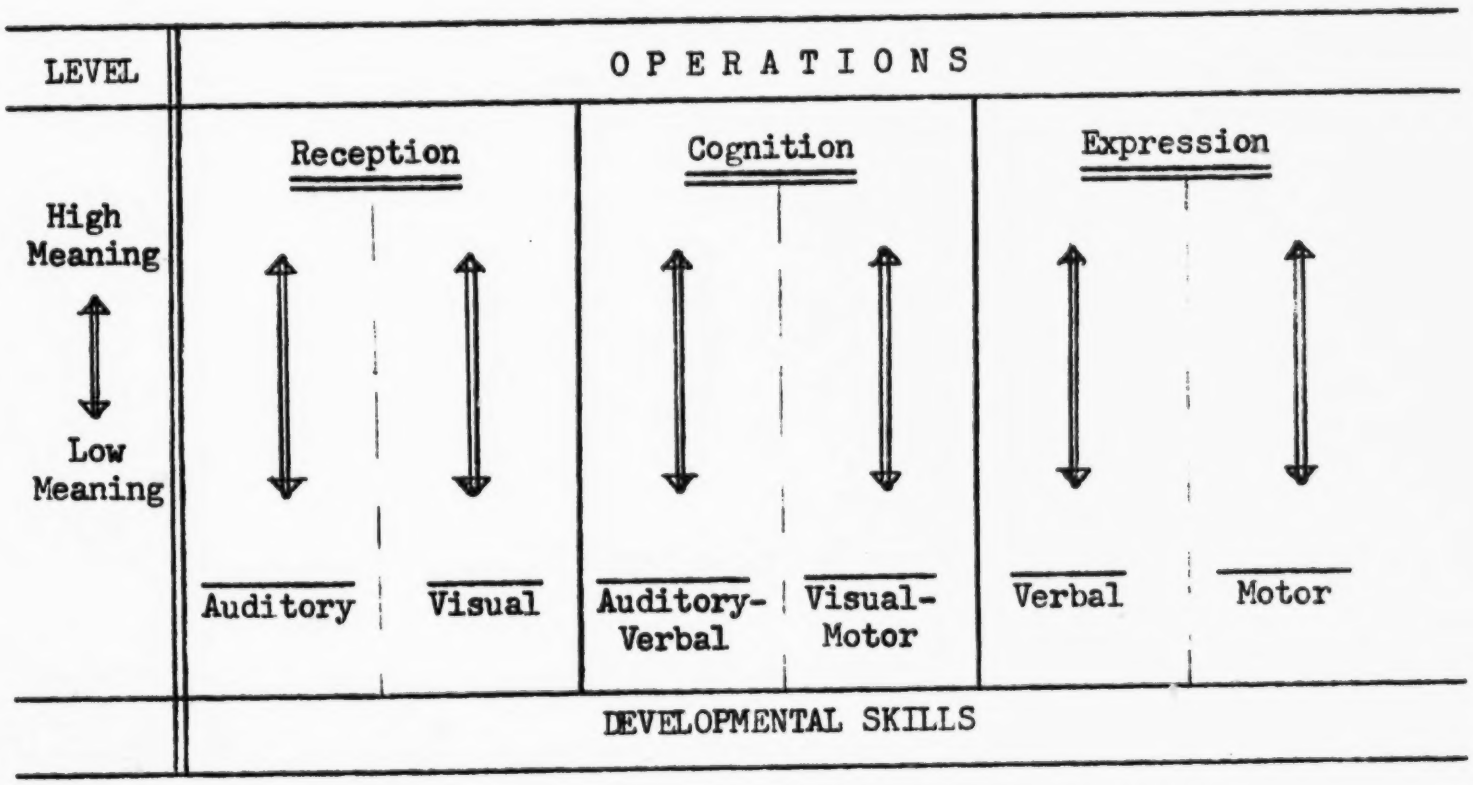

Figure A-1. Model for Developing Intellectual Abilities

Table A-1 provides a brief description of the tests used in this study and the areas the tests are designed to measure (A-auditory, V-visual, C-cognitive, L-language, M-motor, and readiness for the first primary year).

Table A-1. Description of Tests Used and the Areas Measured

SKILLS DEVELOPMENT	Skills Area				
	A	V	C	L	M
The Illinois Test of Psycholinguistic Abilities (ITPA) (1)					
ITPA DECODING TESTS. Understanding the meaning of words and symbols.					
Test 1. Auditory Decoding. The ability to comprehand the spoken word.					
Example: Do airplanes fly? Yes, No Do bicycles drink? Yes, No	X				
Test 2. Visual Decoding. The ability to comprehand pictures.					
Example: Picture of Shoe - Find another (different) shoe.		X			
ITPA ASSOCIATION TESTS. Relating visual or auditory symbols (ideas) in meaningful ways.					
Test 3. Auditory-Vocal Association. The ability to relate spoken words in a meaningful way.					
Example: I sit on chair - I sleep on _____. Coffee is bitter - Sugar is _____.			X		
Test 4. Visual-Motor Association. The ability to relate meaningfully visual symbols.					
Example: Sock goes with shoe, cup goes with spoon.			X		
ITPA ENCODING TESTS. Putting ideas into words and gestures.					
Test 5. Vocal Encoding. The ability to express ideas in spoken words.					
Example: Tell all about a - - - Ball, chalk, block, celluloid.				X	
Test 6. Motor Encoding. The ability to express one's ideas in gestures.					
Example: Gun - point, pull trigger. Telephone - dial, put to ear.					X

Table A-1. (continued)

SKILLS DEVELOPMENT	Skills Area				
	A	V	C	L	M
ITPA AUTOMATIC TEST. Handling syntactical and inflectional aspects of language without conscious effort.					
Test 7. Auditory-Vocal Automatic Test. The ability to anticipate what will be said based on what has already been said.					
Example: Here is a bed, here are two beds.				X	
ITPA SEQUENCING TESTS. Reproducing a sequence of symbols.					
Test 8. Auditory-Vocal Sequencing. The ability to repeat a sequence of symbols previously heard.					
Example: Repeating 2 to 8 digits.			X		
Test 9. Visual-Motor Sequencing. The ability to reproduce a sequence of symbols previously seen.					
Example: △ □ ○ ⬡ etc.			X		
TOTAL ITPA L.Q. Composite Score. Derived from chronological age and total standard score.	X	X	X	X	X

READINESS TEST	Readiness Area
The Metropolitan Readiness Test (6)	Reading Number Total

APPENDIX B

THE MANOVA ANALYSES

The statistical significance of differences between test scores of two or more groups, or on two or more measures can be determined by a multivariate analysis of variance, MANOVA (7), in a Fortran operating system. The analyses, as used in the present study, provides:

1. A multivariate test of significance using Wilk's lambda criterion and canonical correlations to establish overall significance of the data. The test indicates the significance of correlated variables and is a safeguard against the possibility that a certain percentage of the variables might be significant only by chance. (The usual t-test procedures alone do not provide this safeguard.)

2. A set of univariate F tests which indicate the significance of each variable among the groups, assuming independence.

Both the Wilk's lambda test and the univariate F tests are expressed in terms of p (percentage) values. For example, a p value of .01 indicates less than one percent possibility the findings resulted by chance; a p value of .001 indicates less than one tenth of one percent possibility the findings resulted by chance. In this study, p greater than .05 is not considered significant (ns).

The MANOVA program is a more severe test of significance than the usual t-test procedures alone because it processes all variables (age, sex, group, test scores) simultaneously after which the usual t-test procedures can be applied with considerable confidence.

APPENDIX C

Table C-1. Significant t-Tests of Total Raw Score Differences on the ITPA Pretest, Posttest, and Posttest-Pretest Growth for Boys in the Six Classes

Test/ Class	School					
	E	F	D	A	Ave.	B
PRETEST						
E						
F						
D						
A	2.24***	2.30***				
Ave.	-2.27***	-2.13***				
B	5.06*	5.42*	4.16*	-3.77*	2.50**	
C	4.35*	4.69*	3.58*	-3.88*	3.32*	
Univariate F Test: p Less than .001 Wilk's Lambda Criterion: p Less than .001						
POSTTEST						
E						
F	-3.26*					
D	3.66*					
A	5.90*	2.32***	2.89**			
Ave.	-3.73*					
B	6.84*	3.40*	3.71*			
C	6.77*	4.09*	4.25*	-2.56***	3.06*	
Univariate F Test: p Less than .001 Wilk's Lambda Criterion: p Less than .001						
POSTTEST-PRETEST GROWTH						
E						
F	-3.48*					
D	2.41***					
A	5.36*		2.39***			
Ave.	-2.66*			2.53**		
B	2.08***			2.91*		
C						
Univariate F Test: p Less than .002 Wilk's Lambda Criterion: p Less than .028						
Level of Significant t-Tests for Age of Boys. Class D with Class B: t = 2.65** Class F with Class B: t = 3.27*						

Level of Significance using the two-tailed t-test:

* > .01
** > .02
*** > .05

Table C-2. Significant t-Tests of Total Raw Score Differences on the ITPA Pretest, Posttest, and Posttest-Pretest Growth for Girls in the Six Classes

Test/ Class	School					
	E	F	D	A	Ave.	B
PRETEST						
E						
F						
D						
A	2.10***					
Ave.	-2.36**					
B	5.41*	3.39*	2.98*	-2.94*		
C	5.72*	4.33*	4.33*	-4.44*	4.10*	
Univariate F Test: p Less than .001 Wilk's Lambda Criterion: p Less than .001						
POSTTEST						
E						
F	-5.11*					
D	4.54*					
A	7.51*	2.37***	2.51**			
Ave.	-4.44*					
B	12.09*	4.35*	4.16*		2.15***	
C	9.02*	4.75*	5.01*	-3.27*	3.84*	
Univariate F Test: p Less than .001 Wilk's Lambda Criterion: p Less than .001						
POSTTEST-PRETEST GROWTH						
E						
F	-3.73*					
D	4.07*					
A	7.11*		3.71*			
Ave.	-4.11*			2.92*		
B	3.99*					
C	5.23*			2.19***		
Univariate F Test: p Less than .001 Wilk's Lambda Criterion: p Less than .008						
Level of Significant t-Test for Age of Girls. Class A with Class B: t = 2.23***						

Level of Significance using the two-tailed t-test:

* > .01
** > .02
*** > .05

Table C-3. Significant t-Tests of Raw Score Differences on the Metropolitan Readiness Tests for Boys in the Six Classes

Subtest/ Class	Class					
	E	F	D	A	Ave.	B
READING						
E						
F						
D		−2.63**				
A	2.32***		3.35*			
Ave.			−2.02***			
B	3.53*	3.22*	3.60*	−2.43***		
C	3.62*	3.55*	3.30*	−3.26*	3.30*	
Univariate F Test n.s. (p Less than .076)						
NUMBER						
E						
F						
D						
A	2.25***					
Ave.	−2.51**					
B	5.60*	3.92*	3.45*	−3.52*		
C	6.06*	5.26*	4.28*	−5.19*	4.27*	−3.40*
Univariate F Test: p Less than .001						
TOTAL						
E						
F						
D						
A	3.15*		2.53***			
Ave.	−2.25***					
B	5.14*	4.39*	4.15*	−3.41*		
C	5.13*	4.87*	4.11*	−4.56*	4.02*	−2.68**
Univariate F Test: p Less than .004 Wilk's Lambda Criterion: p Less than .003						

Level of Significance using the two-tailed t-test:

* > .01
** > .02
*** > .05

Table C-4. Significant t-Tests of Raw Score Differences on the Metropolitan Readiness Tests for Girls in the Six Classes

Subtest/ Class	Class					
	D	F	E	Ave.	A	B
READING						
D						
F						
E	−2.77**					
Ave.	−2.41**					
A	3.55*	2.72**	2.09***			
B	5.92*	4.35*	4.07*			
C	5.49*	4.49*	4.36*	4.31*	−3.45*	−2.15***
Univariate F Test: n.s. (p Less than .29)						
NUMBER						
D						
F	−2.28***					
E						
Ave.	−2.21***					
A						
B	5.86*	2.76**	2.89*		−3.33*	
C	5.78*	3.91*	4.17*	4.49*	−4.90*	−2.31***
Univariate F Test: p Less than .013						
TOTAL						
D						
F						
E						
Ave.	−2.34**					
A	3.07*					
B	6.71*	4.69*	4.92*		−2.39***	
C	5.73*	4.55*	4.71*	4.62*	−4.23*	−2.27***
Univariate F Test: n.s. (p Less than .124)						
Wilk's Lambda Criterion: p Less than .011						

Level of Significance using the two-tailed t-test:

* > .01
** > .02
*** > .05

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